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(71) Applicant
Schlumberger Electronics (UK) Limited (United Kingdom),
124 Victoria Road, Farnborough, Hampshire GU14 7PW

(72) Inventor
Richard Wenceslas Laciny

(74) Agent and/or Address for Service
B. D. Stoole, M. Holt,
Schlumberger Electronics (UK) Limited, 124 Victoria
Road, Farnborough, Hants GU14 7PW

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(54) **Weapon training systems**

(57) On a simulated battlefield 10 a simulated direct fire engagement between tanks 11 and 12 is underway. The simulation proceeds by virtue of direct fire weapons simulation, and is subject to the additional simulation of indirect fire. For this purpose the battlefield 10 is notionally divided into an orthogonal grid such that a zone of the battlefield may be identified by a co-ordinate pair. Any zone of the battlefield may be designated as being under attack by indirect fire weaponary, such as zones (B, 2), (E, 3) and (E, 5) which are under artillery fire, zones (0,1) and (F2) which are under mortar fire, and zones (B, 4) and (D, 6) which are mined. Tanks on the battlefield are arranged to receive battlefield information e.g. the areas, type and severity of attack, from transmitter T_o, and further transmissions from transmitters T_1, T_2 so that location may be computed. If a tank is in an area under indirect fire, a kill probability for that fire is computed and a signal given indicating whether simulated damage has been sustained.
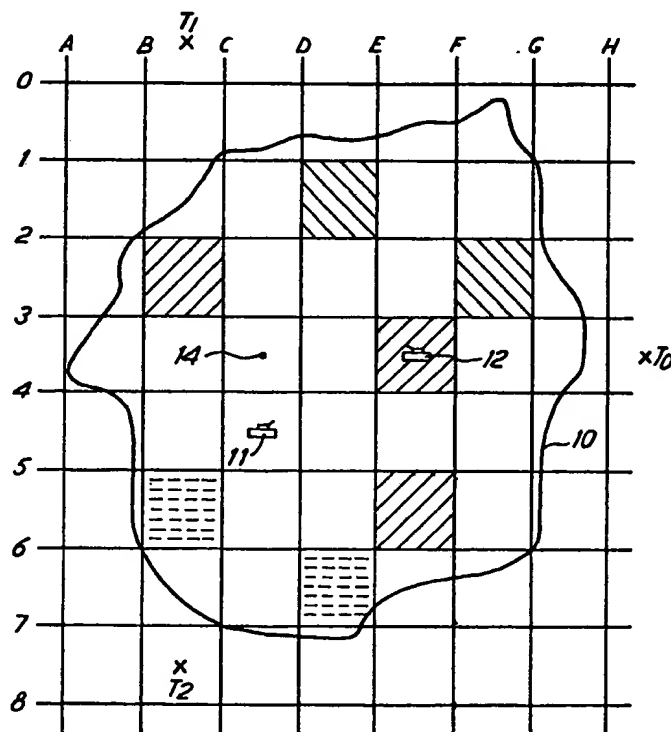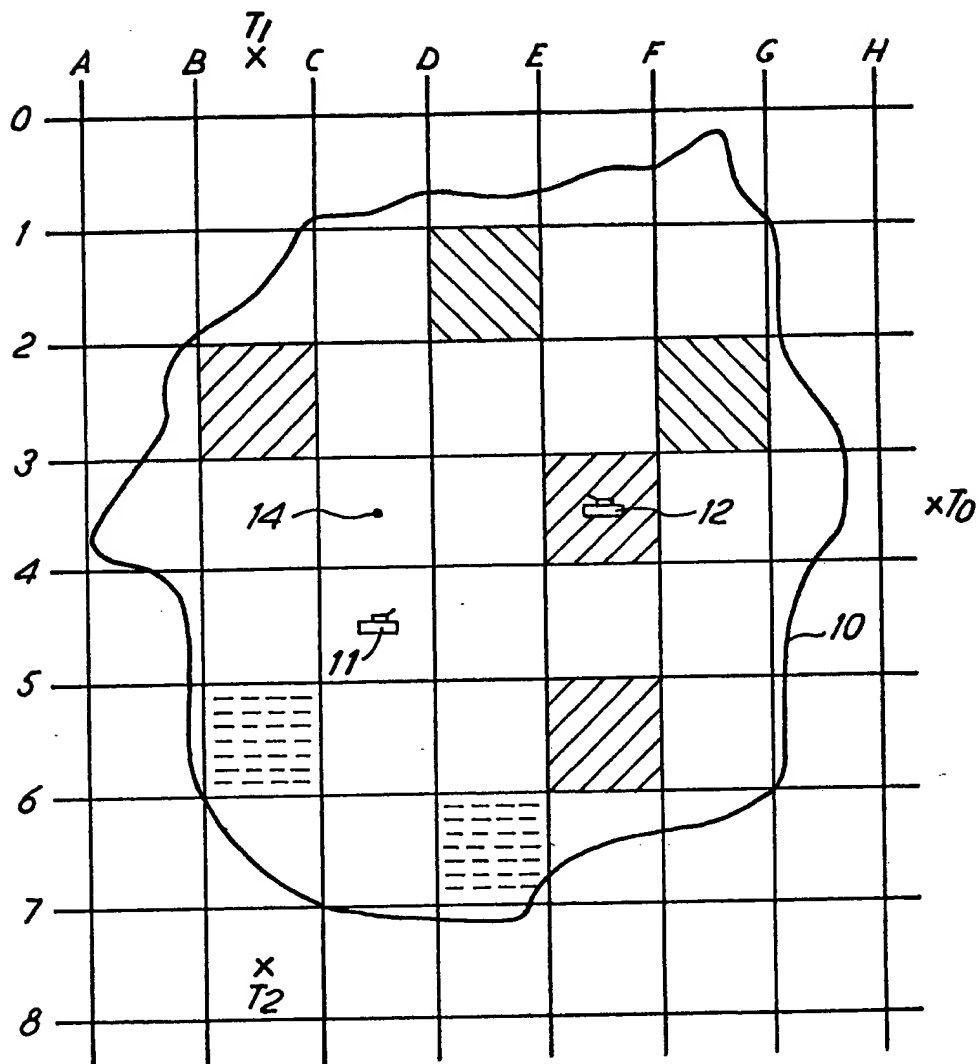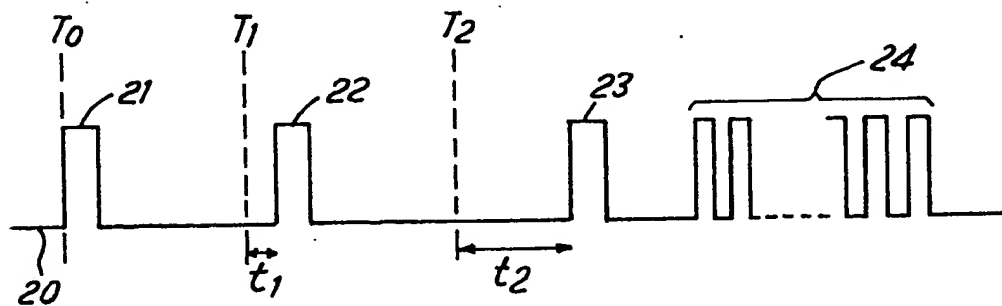

FIG.1

GB 2 176 271 A

FIG.1

FIG.2

SPECIFICATION

Improvements in weapon training systems

5 This invention relates to weapon training systems and in particular to the simulation weapons effects.

Weapon training systems for training weapon operators in aiming and firing procedures
10 without the expense and danger of firing live ammunition are well known and are described in British Patent Specifications Nos. 1 228 143, 1 228 144 and 1 451 192. In these systems, a weapon is typically sighted on a
15 target, and a source of electromagnetic radiation, such as a laser, contained in the training systems and aligned with the weapon, is used to determine the range of the target. Thereafter, the weapon is aimed by offsetting it in
20 elevation and azimuth, to take account of the range (and motion, if any) of the target. When the weapon is 'fired', the laser beam is offset in the opposite sense by the correct amounts for a target having the measured range and
25 motion, so that, if the weapon has been correctly aimed, the offsets applied to the weapon are exactly compensated and the ultimate orientation of the laser beam (the beam datum direction) corresponds to the direction to the
30 target. Energisation of the laser can then be detected at the target to indicate a hit, the information being conveyed back to the weapon site for example by radio. Alternatively a detector at the weapon site may receive radia-
35 tion reflected by a reflector at the target, as for example described in British Patent Specification 1 439 612.

Such systems are in use for the training of personnel in the operation of direct fire wea-
40 pons. There is an increasing need for such systems to have a capability which extends beyond training and to provide a full battlefield simulation. Target mounted equipment may be installed to compute kill probability when inci-
45 dence of radiation is detected, and to indicate that a target has been destroyed so that it may take no further part in the simulation.

Whilst a realistic simulation of direct fire engagement, such as a tank or infantry battle
50 may be provided, indirect fire weapons, such as over the horizon artillery or mortar, or minefields cannot be simulated.

It is an object of the present invention to provide a weapons effect simulator capable of
55 simulating the effects of indirect fire weapons.

According to the present invention an indirect fire weapons effect simulator includes
transmitter means for transmitting information receivable over a battlefield,
60 target mounted receiver means for receiving location and battlefield information, and
target mounted computer means for computing target location in response to said location information, and target kill probability in
65 response to said battlefield information.

Preferably, location information is transmitted by at least three time referenced pulses transmitted from different positions, advantageously by means of a reference pulse
70 from a master transmitter and two delayed pulses from synchronised slave transmitters.

For preference the battlefield information comprises co-ordiante references of designated attack areas and type and severity of
75 attack in each area. Advantageously battlefield information is transmitted by a master transmitter.

In one arrangement of the present invention battlefield attack designations are centrally
80 controlled and may be directly updated.

Alternatively attack designations may be linked to actual weapons operations by way of fully simulting an engagement. Advantageously all simulation computations, including
85 any contemporaneous direct fire engagements, are synchronized to a single reference.

Targets may additionally have transmission capablility so that information about each target may be centrally received, and a complete
90 log of the simulation made available.

In order that features and advantages of the present invention may be appreciated an embodiment will now be described with reference to the accompanying diagrammatic draw-
95 ing of which:

Figure 1 represents a battlefield simulation, and

Figure 2 represents typical target reception.

On a simulated battlefield 10 (Fig. 1) a sim-
100 ulated direct fire engagement between a first tank 11 and a second tank 12 is underway. The simulation proceeds by virtue of direct fire weapons simulation equipment, as for example that described in the preamble to this
105 specification, installed on both tanks.

The engagement is to be subject to the additional simulation of indirect fire and for this purpose the battlefield 10 is notionally divided into an orthogonal grid having co-ordinates (A,
110 B, C, D, E, F, G, H) and (0, 1, 2, 3, 4, 5, 6, 7, 8). A zone of the battlefield may thus be identified by a co-ordinate pair such as (C, 3) which identifies zone 14.

Any zone of the battlefield may be desig-
115 nated as being under attack by indirect fire weaponary, such as zones (B, 2), (E, 3) and (E, 5) which are under artillery fire, zones (0, 1) and (F, 2) which are under mortar fire, and zones (B, 4) and (D, 6) which are mined.
120 Tanks on the battlefield are arranged to receive battlefield information, for example, form radio transmitter T_0, and to compute whether they are in an area under indirect fire, and if so to compute a kill probability for that fire
125 and to signal whether they have sustained damage. Algorithms for assessing kill probability and damage are well known and will not be discussed further here.

In order for target vulnerability to be as-
130 sessed, the zone at present occupied by a

target must be known in addition to the batt-
lefield information. Location may be computed
by receiving transmisssions from two further
transmitters T_1 and T_2. It will be appreciated
5 that placement of transmitters T_0, T_1 and T_2
allows straightforward triangulation, but that in
practice any number greater than two of
transmitters placed at convenient locations
may be used, provided the locations are acu-
10 rately defined, and their positions known to
the target borne computer before the simula-
tion commences.
    In one embodiment of the present invention
transmitters T_0, T_1 and T_2 are pulse transmit-
15 ters, T_0 arranged as a master and T_1 and T_2
as slaves. T_0 transmits a pulse, which may be
regarded as a reference or synchronising
pulse, which preferably acts to synchronise all
simulation operations. Slave transmits T_1 and
20 T_2 are arranged to transmit a further pulse
after a fixed delay following reception of the
reference pulse. The fixed delay in transmis-
sion of transmitter T_2 may for example be
twice that of transmitter T_1. It will be appreci-
25 ated that by measuring the time delays in ac-
tual reception of pulses from T_1 and T_2 after
the known transmission times respectively, su-
fficient information is available for target loca-
tion to be computed.
30 For a typical reception pattern 20 (Fig. 2),
pulses 21, 22 and 23 are received. Pulse 21
is the reference pulse.
    Pulse 22 is received from transmitter T_1 at a
time t_1 after actual transmission and pulse 23
35 from transmitter T_2 at t_2 after actual transmis-
sion of that pulse. Pulse train 24 represents
transmission from transmitter T_0 of battlefield
information, which is coded information about
areas under attack, and attack severity. Fur-
40 ther transmissions follow each reference pulse.
    Initially and before simulation a target, such
as for example tank 12 (Fig. 1) is loaded with
information giving transmitter location,
transmission delays and intial battlefield desig-
45 nations. For a simple simulation, the battlefield
designations may remain unchanged and no
further battlefield information need be
transmitted. Generally however, it is desirable
to change battlefield configuration as the simu-
50 lation proceeds.
    During simulation reference pulses are re-
ceived by tank 12. Following each reference
pulse are location pulses, from which a tank
mounted computer computes in which zone
55 the tank is currently located. Battlefield infor-
mation is then received and monitored for in-
formation about the currently occupied zone.
In the present example, zone (E,5) occupied
by tank 12 is designated as under artillery
60 attack. Tank 12 computer loads information
relating to zone (E, 3) and performs a kill pro-
bability computation based on the received na-
ture and severity of attack. This cycle is re-
peated with each reference pulse as the simu-
65 lation proceeds and is additional to any direct

fire engagement (for example with tank 11)
under simulation, computations for which may
also be synchronised by transmitter T_0 refer-
ence pulses.
70 Battlefield designations may be externally
controlled by updating a battlefield master
store, which holds battle fild information to be
transmitted. Thus a simulation umpire may
control indirect fire simulation from a console.
75 Alternatively the scope of the simulation
may be considerably extended by updating the
store from actual weapons simulations, for
example actual operation of over the horizon
mortars, provided suitable simulation and
80 transmission equipment is attached to the
weapons for their simulated operation to be
input to the store.
    Preferably actual firing co-ordinates are
used. Where artillery is to be simulated, the
85 battlefield store may be advantageously inter-
faced to an artillery fire control system.

CLAIMS
    1. An indirect fire weapons effect simulator
90 including:—
    transmitter means for transmitting informa-
tion receivable over a battlefield,
    target mounted receiver means for receiving
location and battlefield information, and
95 target mounted computer means for com-
puting target location in response to said loca-
tion information, and target kill probability in
response to said battlefield information.
    2. An indirect fire weapons effect simulator
100 as claimed in claim 1 and wherein location
information is transmitted by at least two time
referenced pulses transmitted from different
positions.
    3. An indirect fire weapons effect simulator
105 as claimed in claim 1 or claim 2 and wherein
the battlefield information comprises co-ordi-
nate references of designated attack areas
and/or attack type and/or attack severity.
    4. An indirect fire weapons effect simulator
110 as claimed in claim 1, claim 2 or claim 3 and
wherein the attack designations are centrally
controlled.
    5. An indirect fire weapons effect simulator
as claimed in any preceding claim and wherein
115 the battlefield information includes data to infl-
uence kill probabilty computations of a direct
fire simulation.
    6. An indirect fire weapons effect simulator
as claimed in any preceding claim and wherein
120 the battlefield and location information is de-
rived at least in part from an artillery fire con-
trol system.
    7. An indirect fire weapons effect simulator
substantially as herein described with refer-
125 ence to the drawings.